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Predation and selection in copepod populations of Alpine waters.

Boll.Zool. 21, 541-545 1954

Translated by: W.J.P. Smyly.

The Diaptomidae which are found in lakes in the high parts of the Alps, are represented almost exclusively by two species: Arctodiaptomus bacillifer (Koelb) and Acanthodiaptomus denticornis (Wierz). A.denticornis is generally found in relatively warmer water than Arctodiaptomus bacillifer, and consequently there are some parts of its altitudinal range in which A.bacillifer does not occur. There is an altitudinal band, lying roughly between 1800 and 2200 m in which one can find populations of both species. Generally speaking, presence of one of the two diaptomid species in a water-body means exclusion of the other, and this region undoubtedly should be studied because of the strong competition between these two species which results from identical food needs and the impossibility of finding in the uncomplicated pelagic zone of an alpine lake an ecological means of confining in different places each of the two forms.

Study of zooplankton populations of unproductive lakes of the two watersheds of the alpine chain, studies carried out by different workers on hundreds of different water-bodies, enables one to say that A.bacillifer and Acanthodiaptomus denticornis have been found together in only four lakes; in one lake, a very deep lake, inadequate sampling is possible. The contemporaneous presence in the pelagic zone of adult forms of the two species seems in each case to be limited to a brief period of time (only a few days), the biological cycles being separated in time, first to appear and mature being Arctodiaptomus bacillifer and then Acanthodiaptomus denticornis.

Of the four lakes referred to, one is in Isvizzera: Lej Nair at 1860 m., Engadina (Imhof, 1886, 1890): one in France, Lac de Darbon at 1816 m, High Savoy (Dussart, 1948) and two in Italy: Lago di Monscera at 2071 m., Domodossola (Tonolli, V., 1949) and Lago della Valli Inferiore at 1950 m, Schilpario, (Tonolli, V. & L. 1951).

The features that characterize these four lakes are:

1) The presence in the zooplankton of three of them (Darbon, Nair and Monscera) of a common predator, Heterocope saliens Lill (F.J.I.) which can hardly be accidental considering the relative scarcity of Heterocope populations.

2) The low altitudes: The lakes studied are situated at the low limit of the altitudinal range in distribution of Arctodiaptomus bacillifer and somewhat towards the upper limits of Acanthodiaptomus denticornis. This fact assumes greater importance when one considers that within this altitudinal range the frequency of lacustrine phenomena increase progressively with height.

3) Characteristic physiographic features signifying conditions whereby thermal adaptation of the water mass is more rapidly adjusted to the external temperature.

We deal with lakes of very modest dimensions and of small depth, subject to considerable lowering of level in summer (Monscera & Darbon) with consequent possibility of calorific radiation extending down to the deepest parts; and with very modest drainage basins (two of these - Monscera & Valli Inferiore, are located on passes) and hence with small exchange of water.

We can perhaps infer that we are dealing with lakes in which - on account of the altitude and physiographic characters - one finds from the thaw to the time of maximum summer atmospheric temperature, a thermal transition of the water of considerable importance, whereby there is in early summer a thermal conditioning suited to the colder needs of Arctodiaptomus bacillifer and Heterocope and in the second half of summer to the needs of Acanthodiaptomus denticornis.

This condition makes a succession of two diaptomids possible but we cannot state the determining factors precisely only that under colder and warmer conditions we find populations established of Arctodiaptomus bacillifer & Acanthodiaptomus denticornis which reproduce normally and maintain adult forms until the lake freezes over.

It may be that this phenomenon is mainly caused by the presence of Heterocope. If in a lake Heterocope and Arctodiaptomus bacillifer live together, we have the usual balance between prey and predator, whereby some individuals of the two species are present throughout the warm season. But if in such an equilibrium, a population of Acanthodiaptomus denticornis is introduced, the equilibrium between Heterocope and Arctodiaptomus bacillifer will be altered because Acanthodiaptomus denticornis, with its delayed biological cycle can then supersede Arctodiaptomus bacillifer at a definite seasonal time, as prey of Heterocope. The duration in the pelagic zone of A. bacillifer during the whole summer season is no longer controlled by the restraint of the Heterocope population, which in respect to food, it controls, and at the same time is interfered with by feeding competition exerted by Acanthodiaptomus denticornis.

In effect, in those lakes where the two diaptomids co-occur, there is a more rapid unfolding of the biological cycle of Arctodiaptomus bacillifer and a corresponding slowing down of that of Acanthodiaptomus denticornis.

This state of affairs can justifiably be ascribed to selective factors which originate in competition for food between the two diaptomids and in predatory pressure on the part of Heterocope, and in an environment which, at successive times, provides thermal conditions suitable for all three species.

We have verified that in three of these four lakes, A. denticornis is present in the absence of Arctodiaptomus bacillifer, and vice versa respectively in the second and first parts of the lacustrine summer.

In the fourth lake, Monscera, we have been able to follow more or less a repetition of the succession in four different years (Tonolli 1949; Bossoni & Tonolli 1954) such that we have been able to attribute a decisive value, for the period of replacement, on the differences in the summer atmospheric temperature in each year.

Absence of the pelagic forms of A. bacillifer from the lake of Monscera has been noted between 10 July (in the warmer 1947) and the 21 Aug. (in the cooler 1946), periods in which its biological cycle was being concluded with laying of resting eggs.

This fact acquires a definite significance when one considers that in ten other lakes of the high Val Bognanco, located between 2002 and 2340 metres and colonized by A. bacillifer, this diaptomid is present in all stages of development or as adult egg-laying females in the third part of September in each of five years between 1946 and 1958 (Tonolli 1954), which is generally true of A. bacillifer populations.

We must therefore conclude that cohabitation of Heterocope and Acanthodiaptomus denticornis has selectively produced a population of Arctodiaptomus bacillifer characterised chiefly by attaining sexual maturity and laying resting eggs at a time much earlier than normal in reproductive isolation and increased as usual by geographical isolation common for pelagic Entomostraca.

Notice

Please note that these translations were produced to assist the scientific staff of the FBA (Freshwater Biological Association) in their research. These translations were done by scientific staff with relevant language skills and not by professional translators.